SCREENING

435 Lecture Notes by Qusay Ajlan & Ahmed Alyahya & Haifaa Almohsen

Original Content | **Titles** | Additional Notes | **Important**

Learning objectives

- Define the term “screening”
- Explain the concept of screening and the lead time
- Explain the difference between “screening”,

“case finding”, “periodic examination” and “diagnosis”

- State the uses of screening programs
- State the criteria of health problems amenable for screening
- Outline the differences between screening and diagnostic test
- Distinguish between “mass screening” and “high risk screening”
- State the criteria of an ideal screening test

Performance objectives

- Compute sensitivity, specificity and predictive values of a screening test
- Evaluate the performance of a screening test

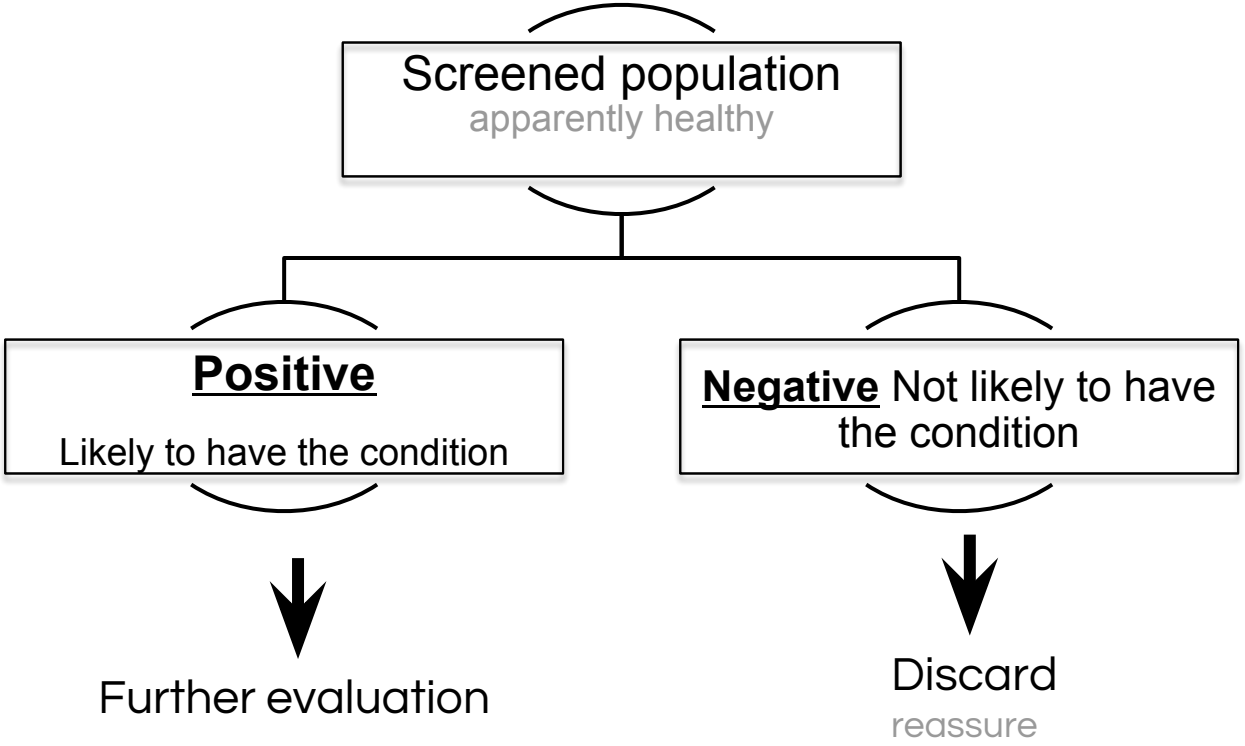
Definition of screening

"Screening is defined as the search for unrecognized disease or defect by means of rapidly applied tools in apparently healthy individuals not seeking medical care" screening is "searching for diseases in **apparently normal people**"

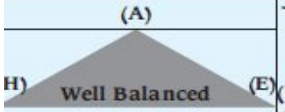
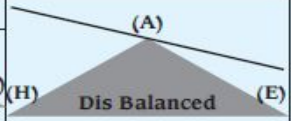
Screening tools could be not all types of screening have to be done by health care providers

- Test consisting a series of questions
- Instrument to measure a parameter
- Medical examination
- Radiological test
- Laboratory test

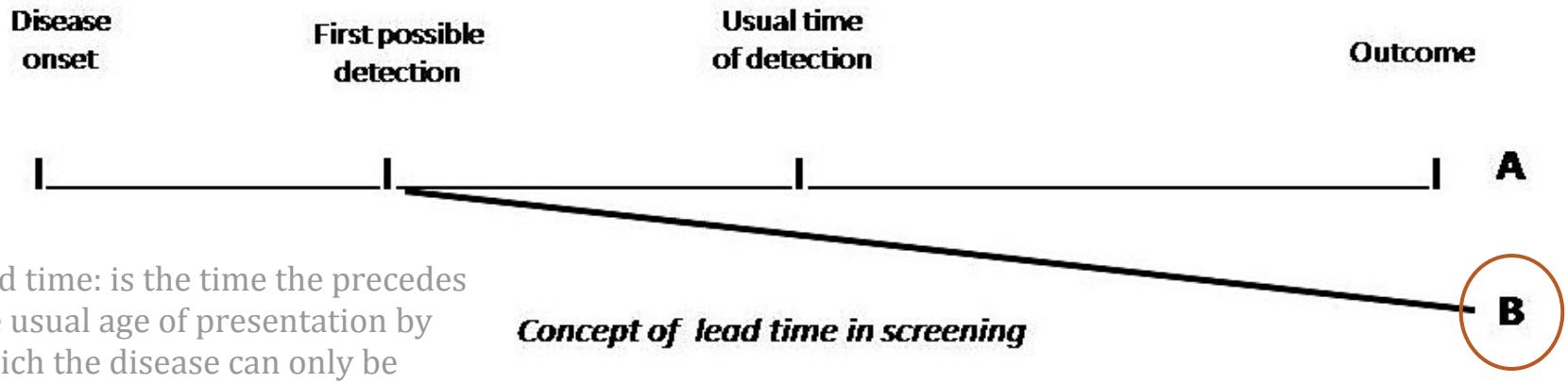
OUTCOME OF SCREENING



NATURAL HISTORY OF DISEASE AND LEVELS OF PREVENTION

		Stages of Pathogenesis			
Stage of Positive Health	*Stages of Susceptibility (Pre Pathogenesis)*	*Asymptomatic (Early Pathogenesis)*	*Early, Discernible Disease*	*Full-Blown (Classical) Disease*	*Termination*
		Pathological process has started. However, outwardly, there are no signs or symptoms what so ever. Detection is only possible by specialized pathological / investigative studies.	There are very mild or non-specific signs / symptoms which occur at a very early stage of clinical course; not easy to detect at this stage unless very fine clinical acumen and / or specialized equipment is used.	Full fledged disease in classical form; quite easy to diagnose.	- Complete Recovery - Chronic Disease - Life With Residual Disability - Death
Agent, Host and Environmental factors are in perfect balance	Balance between Agent, Host and Environmental Factors is disturbed; conditions have been created for disease process to start; however pathological processes have still not started.				
Health Promotion	Specific Protection	Early Diagnosis and Prompt Treatment		Disability limitation	Rehabilitation
Primary Prevention		Secondary Prevention		Tertiary Prevention	
Levels of Prevention					

CONCEPT OF LEAD TIME



Concept of lead time in screening

lead time: is the time the precedes the usual age of presentation by which the disease can only be detected by screening tests. When we detect the disease in this period we may change the prognosis of the disease.

DIFFERENCE BETWEEN SCREENING AND

Periodic examination

Seeking of medical care at intervals to evaluate health status and to detect any health problem without the presence of any complaint. In periodic examination, different systems are looked at and a series of investigations are applied.

Case finding

The use of a clinical, laboratory or non laboratory test to detect disease in individuals seeking health care for other reasons. The aim of identifying diabetes among pregnant women is an example of case finding.

Diagnosis

A procedure to confirm or refute the existence of a disease or abnormality among those seeking medical care with a specific complaint. Achieved by obtaining medical history, clinical examination and the application of laboratory or non laboratory tests.

SCREENING & DIAGNOSTIC TEST

Screening tests	Diagnostic tests
Applied to apparently healthy or asymptomatic	Applied to those with specific complaint or suggestive signs or symptoms
Applied to a group of individuals	Applied to a single person
Results are based on one criterion	Results are based on the evaluation of a number of symptoms, signs and result of investigations
Results are not conclusive	Results are conclusive and final
Less accurate	More accurate
Less expensive	More expensive
Not a basis for treatment	Basis for treatment

USES OF SCREENING TESTS

- **Case detection**; It is identification of unrecognized disease or defect that doesn't arise from patients' request

- **Control of diseases**; This is with the purpose to prevent the transmission of the disease to healthy community members

- **Research purposes**; initial screening is conducted to estimate the prevalence of a disease and subsequent screening will provide data on the incidence

TYPES OF SCREENING PROGRAMS

- **Mass screening**; applied to the whole population or population subgroups as adults, school children, industrial's workers irrespective of their risk.

- **High risk or selective screening**; applied to a selective population subgroups who are at a high risk. Among high risk population, the disease is more likely to be prevalent and the screening will result in a better yield.

ELIGIBLE CONDITION FOR SCREENING

- Major public health problem and/or have serious consequences
- High prevalence among screened population so we don't screen for a rare disease that is not considered a public health problem (even if it's serious e.g. myasthenia gravis)
- Have a detectable pre-clinical phase
- Availability of test for detection in pre-clinical phase
- Evidence that early detection reduces morbidity and mortality
- Available facilities for the confirmation of the diagnosis
- Agreed-on policy whom to treat as a patient
- Available of effective treatment for the disease if identified
- Expected benefits of early detection out-weight the risks and costs of screening

EXAMPLES OF SCREENING

- Blood pressure for hypertension
- Fasting blood sugar level for diabetes
- Pap smear for cervical cancer
- Mammogram for breast cancer
- PSA for prostate cancer generally speaking, cancers that have screening tests are less likely to cause death
- Elisa followed by RIBA for hepatitis C antibodies *RIBA = recombinant immunoblot assay
- Thyroid hormone from blood cord for hypothyroidism in newborn
- Hip examination for congenital hip dislocation in the newborn

IDEAL SCREENING TOOL

Feasibility

Simple, inexpensive, capable of wide application

Acceptability

Acceptable by the people to whom it is intend to be applied

Reliability (precision) "reproducible"

Consistent results on repeated application on the same individual under same circumstances

Validity (accuracy)

Ability to distinguish between those who have and those who don't have the disease as confirmed by a gold standard

VALIDITY

- Validity of the test reflects its “accuracy” compared to a gold standard.
- to test a new diagnostic or screening test for a certain disease, we compare its values with the known gold standard test to determine its validity
- Validity has two components
  - Sensitivity: ability of the test to detect correctly those who truly have the condition (true positive)
  - Specificity: ability of the test to detect correctly those who truly don’t have the condition (true negative)

Screening test results	Gold standard		Total
	Diseased	Not diseased	
Positive	a True positive	b False positive	a+b
Negative	c False negative	d True negative	c+d
Total	a+c	b+d	a+b+c+d

Sensitivity: ability of the test to detect correctly those who truly have the condition (true positive)

$$\text{Sensitivity} = \frac{a}{a+c}$$

Specificity: ability of the test to detect correctly those who truly don't have the condition (true negative)

$$\text{Specificity} = \frac{d}{b+d}$$

Test	Breast cancer		Total
	Positive	Negative	
Positive	900	1980	2880
Negative	100	97020	97120
Total	1000	99000	100000

EXAMPLE

Sensitivity (900/1000)x 100 = 90.00%

Specificity (97020/99000) x 100 = 98.00%

- **Sensitivity:**
  - the test was capable to identify correctly 90% of the those who have the condition
  - The false negative rate ($\frac{c}{a+c}$) is only 10% (10% is complementary to the sensitivity which is 90%)
- **Specificity:**
  - the test was capable to identify correctly 98% of the those who don't have the condition
  - The false positive rate ($\frac{b}{b+d}$) is only 2%

Test	Breast cancer		Total
	Positive	Negative	
Positive	900	1980	2880
Negative	100	97020	97120
Total	1000	99000	100000

EXAMPLE

Sensitivity (900/1000)x 100 = 90.00%

Specificity (97020/99000) x 100 = 98.00%

- Sensitivity:
  - A sensitive test will result in few false negative
  - Test with high sensitivity is preferable in screening
- Specificity:
  - A specific test will result in few false positive
  - Test with high specificity is preferable for diagnosis

sensitivity=rule out= screening tests (for screening we need a test that can rule out patients with minimum false negative rates)

specificity= rule in (confirmatory diagnostic test by which I need a high true positive rate and minimum false positive rates; that is what I need to confirm diagnosis)

YIELD OF THE TEST

- Yield of the test reflects the number of correctly unrecognized subjects with the condition who have been identified and brought into care

- Yield of the test is measured by its predictive value
  - Predictive value positive (Pv_{+ve}) is the probability that a person positive by the test truly have the condition

$$Pv{+}ve = \frac{a}{a+b}$$

Wrong dr gosadi said to replace the word positive and put negative

  - Predictive value positive (Pv_{-ve}) is the probability that a person negative by the test truly don't have the condition

$$Pv\text{-}ve = \frac{d}{c+d}$$

Test	Breast cancer		Total
	Positive	Negative	
Positive	900	1980	2880
Negative	100	97020	97120
Total	1000	99000	100000

Sensitivity (900/1000)x 100 = 90.00%

Specificity (97020/99000) x 100 = 98.00%

PV + ve (900/2880) x 100 = 31.25%

Among those who had a positive screening test, the probability of disease was 31.25%

PV – ve (97020/97120) x 100 = 99.89%

EXAMPLE

- Pv+ve:
  - Out of those who are positive by the test only 31.25% are found to have the condition "the probability that subjects with a positive screening test truly have the disease."
- Pv-ve:
  - Out of those who are negative by the test, 99.89% are found to be free from the condition "probability that subjects with a negative screening test truly don't have the disease."

Test	Breast cancer		Total
	Positive	Negative	
Positive	900	1980	2880
Negative	100	97020	97120
Total	1000	99000	100000

Sensitivity (900/1000)x 100 = 90.00%

Specificity (97020/99000) x 100 = 98.00%

PV + ve (900/2880) x 100 = 31.25%

PV – ve (97020/97120) x 100 = 99.89%

Q: Is it a good test for screening?

EXAMPLE

Test	Breast cancer (Prevalence 1%)		Total
	Positive	Negative	
Positive	900	1980	2880
Negative	100	97020	97120
Total	1000	99000	100000

Sensitivity (900/1000)x 100
= 90.00%

Specificity (97020/99000) x 100
=98.00%

PV + ve (900/2880) x 100
= 31.25%

PV – ve (97020/97120) x 100
= 99.89%

Test	Breast cancer (Prevalence 10%)		Total
	Positive	Negative	
Positive	9000	4500	13500
Negative	1000	85500	86500
Total	10000	90000	100000

Sensitivity (9000/10000) x 100 =90.00%

Specificity (85500/90000) x 100
= 95.00%

PV + ve (9000/13500) x 100
= 66.67% due to increase prevalence

PV - ve (85500/86500) x 100
= 98.84%

PREVALENCE & PREDICTIVE VALUE

YIELD OF THE TEST

- Low predictive value positive of a test is a waste of resources; very few of those who tested positive will be found to have the condition
- High predictive value positive is desirable in screening program; detecting and bringing into care subjects with the condition at a pre-clinical stage Predictive value positive increases considerably with the increase in the prevalence of the condition among the screened population > an almost no change in the others
-
- Predictive value positive increases considerably with the increase in the prevalence of the condition among the screened population Predictive value positive increases considerably with the increase in the prevalence of the condition among the screened population > an almost no change in the others

PROBLEMS WITH FALSE RESULTS

- False positive results are referred to as adverse effects or errors of screening

- False positive result is not desirable
  - It is a waste of resources; incurring the cost of the screening and the confirmation of the diagnosis
  - Unnecessary exposure of subjects to the hazards of the tests
  - Emotional strain of being a probable case

CORRECT RESULTS

- True positive result is desirable
  - It is money well spent
  - Bringing subjects with the condition into care
  - Subjects who incurred the hazards of screening and confirmation of the diagnosis will benefit from therapeutic intervention

- True negative result is desirable
  - Reassurance that they are free from the condition

Thank you